This is a book about trees and their service to man. We are shown the vast forests of other lands, the work of the lumberjacks is described, we visit a sawmill, and learn something about different kinds of wood and their various uses.

*STORIES OF INDUSTRY*

# TIMBER

BY

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FREDERICK WARNE & CO. LTD.
LONDON AND NEW YORK

LONDON

1948

*Reprinted* 1949
*Reprinted* 1957

PRINTED FOR THE PUBLISHERS BY WILLIAM CLOWES AND SONS LTD
LONDON AND BECCLES
214-957

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CHAPTER I

# *The Forests of England*

IF WE could travel back through the ages to the England of some four centuries ago, we should find much of the land covered with fine woods and forests. Let us suppose that we have an aeroplane which can take us where we will, to any part of the world or to any day of the past.

We climb on board and, examining the controls, see a large clock-face round which are many dates. We move a pointer back to 1587 and press the electric starter. There is a roar as the engines gather speed and our 'plane rises into the air.

When we have become used to the swift movement, we look down to the world below. We must be very high, for the earth is no bigger than a large melon and it is spinning backwards at a great rate. Soon it slows down and at the same time our aeroplane begins to lose height. There are the British Isles, like a map in an atlas. There is the English Channel, dividing the south of England from France. It seems as if we are about to dive into the sea; but no! our 'plane circles over the coast. In a few moments it lands gently about ten miles from the sea-shore, in a green forest clearing.

We are about to leave the 'plane when we notice a little cupboard on which is written, in large, blue letters: "INVISIBLE CLOAKS." Having put on the cloaks, we climb to the ground.

We look round wondering which way to go, for on all sides of the clearing are trees, most of which are oaks. Then in the distance we hear a man's voice

English Oak

singing. Then: "Chick, chick, chick, chick." What can this noise be? We start off into the forest to find out.

Soon we come to a rough path marked with wheel-ruts. We decide to follow it. "Chick, chick, chick." The sound is nearer now. At last we enter another clearing, and the mystery is solved.

Two bearded men, clad in strange, rough garments, are driving their long-handled axes deep into the trunk of a great oak-tree. Farther along the track two other men, assisted by a horse, are dragging a thick plank of wood, which, with wedges and saw, they have taken from a log. This they hoist on to a pile of timber by the side of the track.

"This is a tough old tree," one of the axemen remarks, as he pauses to wipe the sweat from his brow.

"Ay," answers his companion; "it must be near a thousand years old."

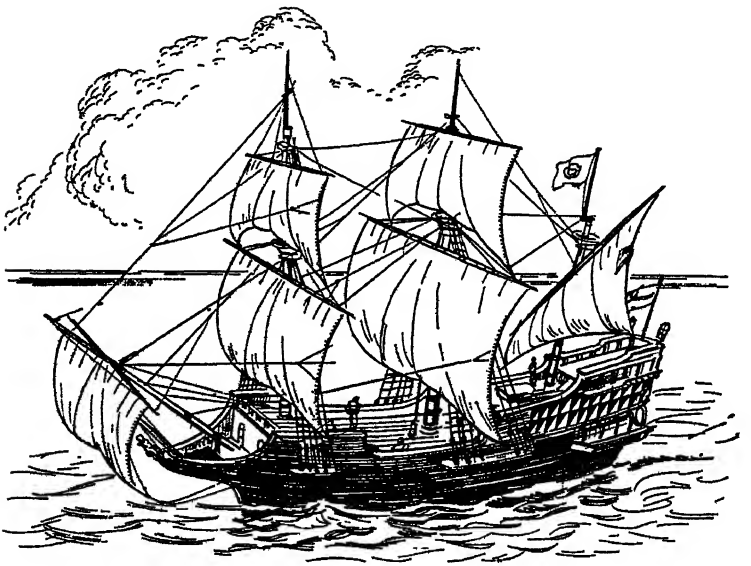
"Now that Francis Drake is home again and our good Queen has gone to war with the Spanish king, it will do better service sailing the seas than standing idle in the forest. To work, Dick! A few more blows will bring it down."

"Chick, chick," go the axes again. There is a creaking and the men spring away. The tree sways and then falls with a crash, its great weight making the ground tremble.

We are so interested that only just in time do we turn and discover that a large wagon drawn by six oxen has come up behind us. We spring from the path and allow it to pass. It stops by the pile of planks and all four men help the driver to load the wagon. Then the wagon moves away and we follow it into the forest.

The load is heavy and the oxen are slow, so we pass them by and follow the path. Leaving the

forest, we cross a broad plain over which the wind brings the smell of the sea. At last we see queer old houses and soon enter a town, whose streets lead to the water's edge. There we overtake another ox-wagon laden with oak planks. We follow it into a



An Elizabethan Ship of Oak

busy shipyard, where many men are at work on the half-built hull of a ship.

She is a small vessel compared with the large ships of our own day, but her ribs and planks, all made of English oak, are strong. We can see that the ship-wrights are proud of her.

They are discussing how Francis Drake sailed round the world in just such a ship as this will be; how he cruised along the Pacific coast of South America, raiding the ports of the Spaniards and capturing their treasure ships, and at last came home with his ship laden with gold and jewels. When Queen Elizabeth dined with him on his ship and made him a knight, King Philip of Spain was so angry that he declared war.

Charcoal Burning

Even now the Spanish king is building a great fleet with which to punish England. That is why these men are working so hard. Soon this ship will put to sea, the black mouths of cannon peeping from her sides, to defend England against the foreign invader.

We know what happened. The great Spanish fleet sailed for England and the ships of English oak met it and defeated it, so that many ships of the Armada never got back to Spain.

When returning along the forest track to our 'plane, we notice some distance away smoke rising among the trees. We leave the path to find out what is happening.

In a clearing an old man, helped by his son, is covering a large stack of wood with earth and sods. Near by is another pile, which has been completely covered. From a hole in the top smoke is rising. They are charcoal burners. When the wood has been covered with earth, so that it will not burn away in flames, it is set alight and allowed to roast for several days. Then the covering is removed and a large pile of charcoal is left. This the charcoal burner will carry in his cart to the iron furnace—to be used, perhaps, to make the cannon for the warship we have seen being built.

As our 'plane carries us back to the present we think of what we have seen. We know now why England has no longer great forests. For hundreds of years the oaks were felled to build not only warships but trading ships as well. More than two hundred years after King Philip's fleet was destroyed, Nelson won the Battle of Trafalgar with ships of English oak. It is said that two thousand oak-trees were required to build one of his ships.

Until men learnt to smelt iron with coal the charcoal

burners helped the ship-builders to cut down the English forests. These men of the past did not plant young trees to replace those they felled. If they had done so, we should still have our great oak forests. Now we must buy nearly all the timber we require from abroad.

## CHAPTER II

# *The Lumber Camp*

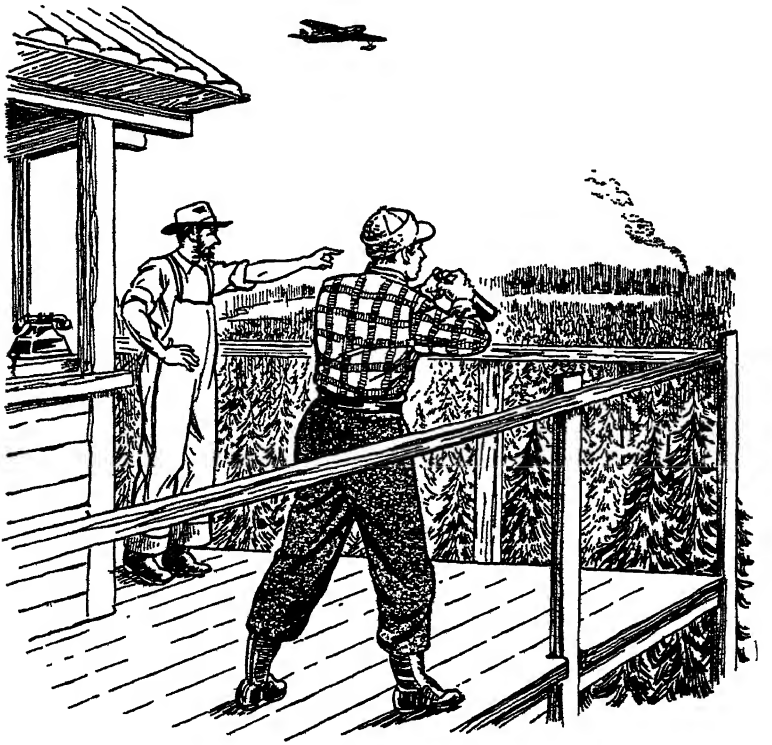
WE HAVE seen how the woods of England helped to build the British Empire. We shall now visit the Dominion that has some of the largest forests in the world.

Our 'plane carries us over the wide Atlantic Ocean and we reach the coast of Canada. We follow the St. Lawrence River, passing over the busy cities of Quebec, Montreal, and Ottawa, the capital of Canada. Already below us are great forests, whose spruce, larch, and hemlock trees each year provide thousands of tons of paper.

In the distance we see an aeroplane. As it comes nearer to us we notice that instead of landing-wheels it has floats. There are few open spaces in the forests, so aeroplanes must land on the lakes or rivers.

Perhaps the pilot is a forest ranger, whose job it is to watch for forest fires. The wood of cone-bearing trees contains much resin, which is easily set alight, and the end of a cigarette, a spark from a railway engine, or even the heat of the sun can cause a fire that may spread over thousands of acres, destroying everything in its path.

Day and night forest rangers watch the forests from high look-out posts. If they see smoke or the glow of fire they at once telephone to headquarters. A float-plane is sent to examine the fire, and fire-



The Look-out Post

fighters hurry to the place. They may find only the remains of a camp fire, that some careless person has left smouldering. But perhaps the forest is ablaze and the wind is spreading the flames. The only way

to deal with a serious fire is to cut down trees before it so that it cannot spread further.

As we fly westwards the forests disappear and we cross the wide prairies, now covered with snow, where in summer corn grows and cattle graze. At last we enter British Columbia, and before us are the great western mountains. Again we see wide forests below us.

Our 'plane lands in a clearing where there are many log huts. It is a lumber camp. This time there is no need to become invisible, for we know that the lumbermen will be glad to see us, for theirs is a lonely life. A man comes towards us and we ask him to take us to the manager.

"He's in the office, I think," he tells us. "Come with me."

He leads us to one of the huts and calls inside: "Some strangers to see you, Monsieur."

A tall man wearing a fur coat and hat shakes hands with us and asks us to sit down.

"Fetch something to eat, Pierre," he orders our guide. Then, when the man has gone, he turns to us and asks: "Now, what can I do for you?"

We tell him that we want to know all about lumbering and that we hope he will be kind enough to let us see his men at work.

"I shall be glad to," he answers. "It's pleasant to have visitors, for it is lonely here in the mountains. [illegible] is Pierre—he is a French-Canadian—with hot [illegible] food. You will find that our food is very

good. My men work hard and I must feed them well."

As we eat he tells us about the camp. We are now in the office, where clerks keep account of the work that is done. Through the window we see other log huts.

"Those huts over there are the bunk-houses, where the men sleep," the manager explains; "that is the cook-house, and the big building is where the men have their meals. Those other huts are where the stores—food, axes, saws, cables, petrol, and so on—are kept. This is not a very large camp. Some camps are like small towns and the men bring their wives and families with them and there are shops, schools, and a hospital."

"But where are the men?" we ask, for so far we have seen no one except Pierre and the manager.

"You will see them soon, when they come in for dinner. The 'yard' where they are cutting timber is half a mile from here. I shall take you there later."

As he finishes speaking the men begin to arrive. They are dressed in all kinds of clothes. Some wear fur caps and coats, others leather breeches and checked shirts. Many are French-Canadians who have been lumber-men for years; some are farmers who have come to the forests for the winter months. Some are from the cities.

"Can anyone cut down trees, then?" we ask.

The manager smiles. "No," he tells us; "only

skilled men can cut down the trees. But there are many other jobs which people can quickly learn.

"We do most of the felling in winter, for then the wood is in the best condition. In the summer these men will go to the cities and spend their wages. You have come at a good time, for this afternoon we are going to begin felling a new part of the forest."

At last the men have finished their meal, and with the manager we follow them to the part of the forest where the cutting is to be done. We have never before seen such big trees. Some of them are three hundred feet high and eight or ten feet thick.

At last we reach the clearing where the felling is being done. Tree stumps stick up through the snow and there are piles of broken branches everywhere. In the middle of the open space is a high mast from which wires stretch in all directions.

"What is that for?" we ask.

"That is called the 'spar.' It is used for moving the logs. As we have cut down all the trees near it, we shall have to 'rig' another nearer to where we shall be felling. Watch those men and you will understand."

At the far side of the clearing a small group of men are examining the trees. At last they stop at the foot of the tallest and straightest. One of them—the "high-rigger," he is called—fastens steel spikes to his boots, passes a circle of rope round the tree and himself, and quickly begins to climb. With his axe he cuts off the branches as he ascends until he is, perhaps, two hundred feet from the ground.

"He will cut off the top of the tree now," the manager tells us. "As you will see, he does not mind heights."

Soon with a crack the "blossom" of the great tree bends and falls crashing to the ground. The man

"Rigger" Topping the Tree

clings to the trunk as it sways backwards and forwards. Our hearts almost stop beating as he climbs to the top and stands there waving to us.

Then, by means of a rope that is fastened to his belt, he hoists up tools and a light pulley-block,

through which runs a rope. After fastening this to the top of the spar, he signals to his helpers below to hoist to him cables, pulley-blocks, and whatever else is needed to "rig" the spar. At last the job is done and the high-rigger climbs down. From the top of the spar to tree stumps round about, wire ropes are stretched.

"These are stays to keep the spar firm—just like the ropes which hold up a tent-pole," the manager explains.

"But what is all this for?" we ask.

"You will understand later. Let us now see how the trees are cut down. There are 'fellers' over there about to start work."

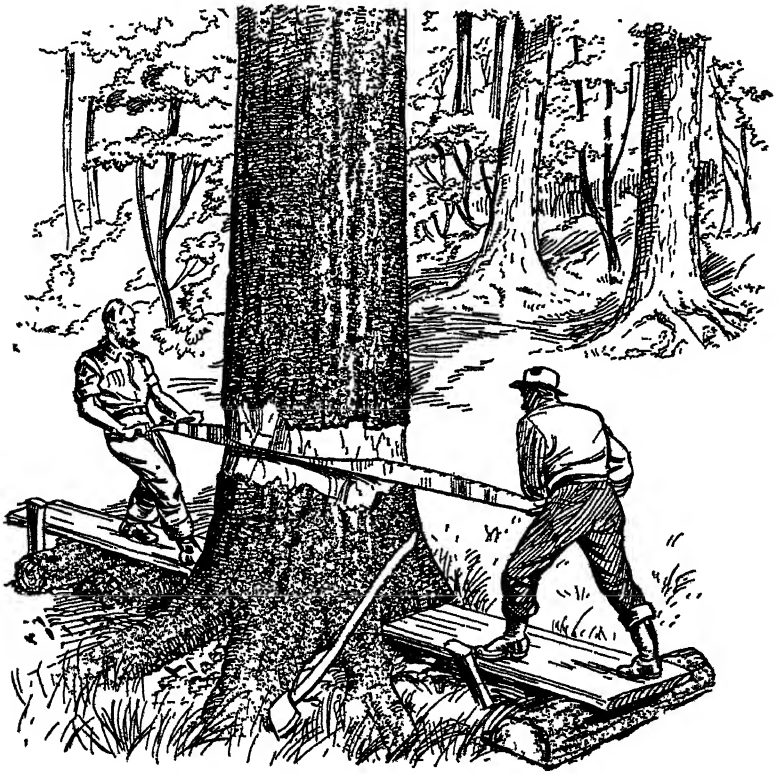
We walk towards where he points and he explains to us that these great trees are Douglas firs or, to give them another name, Columbian pine. Their timber is both strong and light and is a most useful wood.

When we reach the tree that is about to be cut down, we see that two men are chopping two slots in the trunk about two feet from the ground. Into these they put the ends of two planks.

"Those are the spring-boards," the manager tells us. "The fellers stand on them to cut the tree, as you will see. It is very important that the tree falls in the right direction, so that no one will be hurt and so that the logs can easily be carried away. You will see how they do this."

The fellers climb on to the spring-boards and, swinging their long-handled axes, chop a notch about

eighteen inches deep. This is the "undercut" and towards this the tree will fall. Next they take a two-handed saw and begin to cut from the other side



Fellers at Work

of the trunk. As the saw sinks into the wood they drive iron wedges behind it to keep the saw clear and to tilt the tree towards the undercut.

When the teeth of the saw have almost reached the

undercut we hear the tree creak, and this is followed by a loud crack like a rifle-shot. The men spring to the ground and we all run from the tree.

"Timb-e-e-r!" shouts one of the men, and everyone turns to watch.

Slowly the giant tree leans. Then it falls crashing to the ground so that everything for a quarter of a mile shakes.

We approach the fallen giant. The lower end of the trunk is more than seven feet thick.

"However do you carry it away?" we enquire of the manager.

"We cut it up first. Then you will see how useful the spar will be."

Other lumber-men now lop off the branches and top of the fallen tree and a motor-driven saw quickly cuts the trunk into logs twenty or thirty feet long.

"That used to be done by hand," says the manager, with a smile; "but the men like this way much better. Now let us find out what they have been doing with the spar."

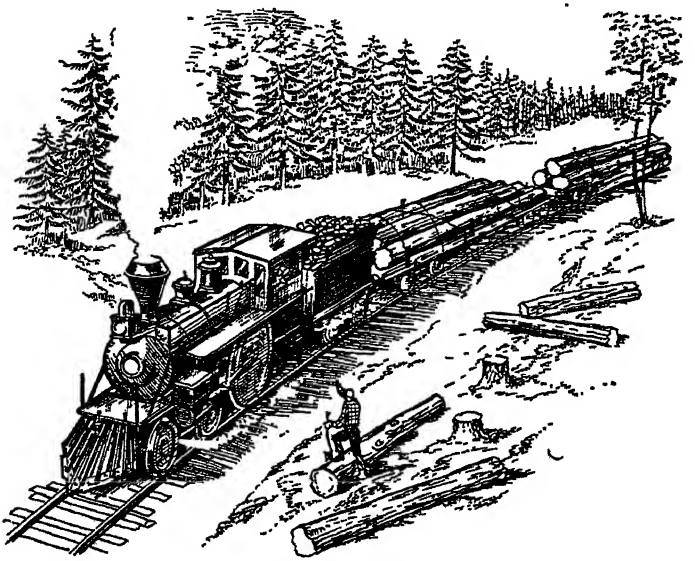
A powerful steam-engine has been moved to the base of the spar. This is called the "yarder." On it there are several winding-drums. From one of these a wire rope passes through a pulley half-way up the spar. Its end, to which are fastened hooks, is being dragged towards the logs which have been cut from the tree.

A man fastens the hooks round the end of a log. Then he blows a whistle. The engineer starts the

yarder and the great log, one end raised from the ground, is dragged bouncing to the spar.

"But what happens to the log now?" we ask. "Why do you bring it here? "

"Over there," the manager points, "is our railway. On the other side of the track they are rigging another



A Log-Train

spar, which will be joined to this one by a wire rope. On that wire rope a hook will travel and that hook will carry the log into position so that it can be lowered on to a railway truck. The yarding engine does that job too. Before these powerful engines came into use, logs had to be moved by horses. That must have been a very long and arduous job indeed."

"And where does the train take the logs?"

"Our railway takes them to the main line, where they are loaded on to other wagons, which carry them to the sawmills. Some lumber camps are near rivers. That makes it much easier, for then logs can be tipped into the water and floated to the mills. That, of course, is the cheapest way.

"One large camp in the United States of America has built its own river for carrying logs! They call this river a 'flume.' It is a long, sloping channel made of wood. When the logs have been placed in it, water is run in at the top and this carries the logs to the sawmills.

"When trees are cut on the steep slopes of hills or in rough country, it is difficult to move the logs to the rivers or to the railway. You must remember that these logs weigh anything up to forty tons. Engineers build an overhead railway, or 'telpher,' as it is called. A strong steel cable is stretched between steel towers and on this cable run carriages. From these carriages are hung the logs. By this means they can be moved easily down the hill-sides or over difficult ground."

While the manager has been talking to us many great trees have fallen, for there are many fellers at work, and they work quickly.

"Surely if you cut down the forest at this rate the time will come when there will be no timber in Canada," we remark to our friend.

He smiles. "The forests are very big, you know,"

he replies; "but what you say would be true if no planting were done. It took people a long time to understand that they could not go on cutting timber for ever, and there was a danger that Canada would lose her forests, as England did. You must remember that each year forest fires destroy almost as many trees as we fell. Careful watch is kept for forest fires by the rangers. But many new trees are planted each year."

## CHAPTER III

# *The River and the Sawmill*

WE MUST wait until the warm winds of Spring thaw the ice on the great Canadian rivers before we set out in our 'plane to follow the logs to the sawmill.

Again we fly over great forests until we see below us a broad river flowing between banks covered with pine-trees. We circle low, and find to our surprise that we cannot see the water for floating logs. The river is full of them from bank to bank. They had been cut in the many lumber camps farther up the river and piled on the banks until the ice on the river should thaw. Then, as soon as the river was clear, the lumber-men, having marked each log with the mark of their company, rolled them into the water so that the current would carry them to the sawmills.

We follow the river downstream, and soon discover why so many logs are crowded together. At a turn in the stream logs have become locked, so that they can move no farther. What will happen now? At this rate all the timber will collect there and never reach the sawmill.

There is something moving on the logs. We fly low to see better. Surely no man dare trust himself there, for the huge tree-trunks are piling on top of

each other? There is a man! There are several men! With long poles they are working to set the logs free. On the soles of their shoes are steel spikes, so that they do not slip on the wet logs. Their poles are called "peevies."

Our 'plane circles so that we can watch. At last a log floats clear of the "jam." Then others follow,

A Log Jam

and the great mass of tree-trunks begins to move. What will happen to the lumberjacks now? They do not seem to fear the danger, for they cleverly balance, guiding the passing logs with their peevies.

At last the jam is cleared and the logs are again on their way towards the mills. The lumberjacks,

springing from log to log, make their way to the bank, where they will keep watch in case another jam occurs at this bend of the river.

We fly on, following the river to where it joins the great St. Lawrence. In the distance we see smoke, and wonder if it is a forest fire. Then we see that it comes from tall factory chimneys. At last we have reached the sawmill.

We land near the mill, and go in search of the manager. He says he will be glad to show us round.

"We shall go to the 'boom-grounds' first," he tells us, leading the way. "The 'boom' is a sort of dam, built across the river, which allows the water to pass but stops the logs. The lumber-men take charge of the logs which bear the mark of this company, and guide them into the boom-grounds."

We come to a large pool of water connected with the river. It is covered with floating logs. This is the boom-grounds.

"As you see, there are two mills. Over there," the manager points, "is the mill which deals with the smaller logs. Some of these are cut up to be made into paper. Others will be sawn into four-foot lengths to be made into 'shingles'—those are wood roof-tiles.

"The big logs go to the mill which is near to us, and as that is the one under my charge, we shall follow them. I think you will find it interesting."

"How do they lift those great logs out of the water?" we ask.

"Come with me and you will see."

We follow him towards the mill, which is a long building with its end turned towards the boom-grounds.

"We don't only lift the logs out of the water; we take them into the mill at the top floor," the manager smiles. "Look over there."

Logs entering a Sawmill

From the water to an opening in the upper part of the mill building slopes what looks like a stairway. As we watch, a huge log creeps up this and disappears into the mill.

"That is the slipboard," explains the manager. "I suppose you are wondering how we make the logs go upstairs? If you look more closely you will see that

there is a thick chain moving up the middle of the slipboard. That chain is endless—I mean its two ends are joined together. It comes down underneath the slipboard, round a wheel under the water, up the slipboard, round the wheel of the engine that drives it, down again, and so on. On the chain are sharp teeth. There is another log about to enter the mill. You will see what happens."

Two men are guiding the log. One of them is on a wooden platform at the bottom of the slipboard. He is pulling the log with a pole which has a sharp hook at its end. The other is cleverly balancing on another log, while he helps with a sharp-pointed peevie. At last the end of the log is over part of the chain, which is under the water. The sharp teeth on the chain bite into the underside and the end of the log begins to rise up the slipboard. Soon the great log disappears into the mill.

"Why do you take the logs into the top of the mill?" we ask. "Surely it would be easier to float them in."

"Once we have them up there we can roll them where we want them. It is much easier than lifting them from place to place. Let us go inside and see what happens next."

There is so much noise inside the mill that we can scarcely hear each other speak. We climb to the top floor and soon find ourselves looking down the slipboard to the boom-grounds we have just left.

"Here is another log coming in," the manager says. "Now you will see how we cut it into planks."

As he speaks the great log enters the mill and slides forward, coming to rest on a bed of rollers. Almost at once steel arms push the log from underneath, so that it rolls sideways on to a gentle slope. To prevent it from rolling too far, short steel "dogs" spring up from the slope and stop it until the time comes for it to be sawn.

At the lower end of the slope is the "log-loader." This is a platform thirty or forty feet long. It has many wheels and runs backwards and forwards on rails past the lower side of the slope.

The log-loader stops, the dogs disappear and the log begins to roll towards the loader. As it reaches the bottom of the slope other dogs spring up and check it. Then it is gently rolled on to the loader, where steel arms, worked by men called "setters," grasp it and move it into the proper position.

Near the loader is the "sawyer," who is in charge of the job. He pulls a lever and the loader begins to carry the log towards the band-saw. This is a wonderful piece of machinery. The saw blade is an endless band of steel five inches wide and one-sixteenth of an inch thick. On each edge are saw teeth. It travels at high speed round two wheels, which drive it.

On moves the loader. With a shriek the saw bites into the log and its whole side is neatly sliced away. The loader now stops and the setters turn the log. Back comes the loader and another slice is cut away. Two more cuts are made and now the log is no longer

a tree-trunk, but a square length of timber. Very soon this is cut by the band-saw into planks.

"That's how we deal with logs," smiles the manager. "It is really quite easy."

"Yes, with a wonderful saw like that," we agree. "But where do the planks go?"

"They fall on to a conveyer. That is an endless belt that carries them to another part of the mill. Come with me and we shall see what happens there."

We follow him to another large room.

"Some pieces of timber, especially if they come from the outside of a log, have flaws. We cut out the bad pieces, so that what is left can be used. You will see now how it is done."

Planks are being carried sideways up a slope by belts with teeth on them. On each plank there is, somewhere, a part that is not fit to be used. As a plank reaches the top of the slope it passes below a row of circular saws. These are different from the band-saw, for they are wheels of thin steel with teeth cut in their edges. They are going round very quickly.

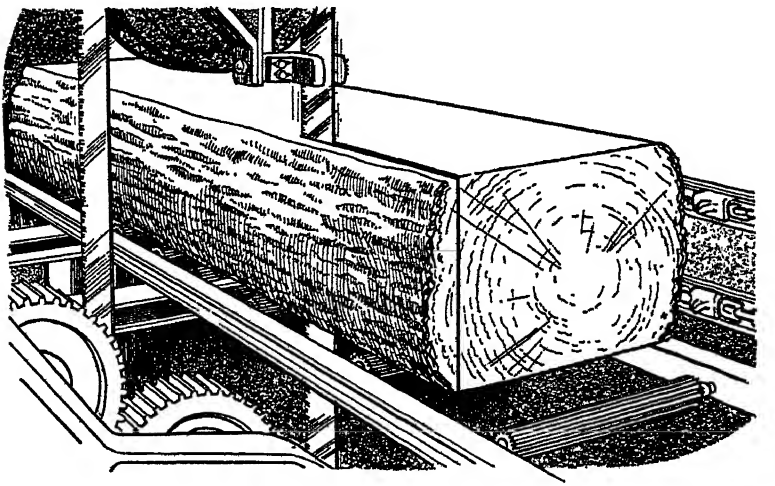
As the plank comes below the saws the man who is looking after the work pulls levers, and certain of the saws come down and neatly cut out the unwanted pieces from the plank.

We now go to the lower part of the mill.

"You know that growing wood contains a great deal of sap," says the manager. "Before timber can be of use to the carpenter or builder this sap must be dried, or the wood would twist. In the old days

wood was left standing in open sheds, sometimes for years, so that it could become seasoned—that is, dried. Even if we had enough room in our yards for this, we could not spare the time. We can season our timber in less than a week.

"First we test small pieces of the wood in an oven to find out how much moisture they contain. Then



The Band-saw cuts the Log into Planks

the planks are placed in the drying-rooms, where the air is just warm enough to season them.

"All we have to do now, before the wood is ready to send away to the people who will use it, is to make it smooth. That is done by the planing-machines, and here they are."

We enter a large room, where many men are at

work. There is so much noise that we have to shout to make our voices heard. The planks of wood are carried by turning rollers along long tables to the planing machines. At each machine stands a man, who guides the end of the plank into the machine. The machine does the rest. The wood is drawn forward while revolving cutters plane the top, bottom, and sides of the plank at the speed of sixty-five feet a minute. Out comes the wood at the other end of the machine clean and smooth, to be carried away on other rollers.

"You will notice that there is no sawdust anywhere," the manager says. We have been wondering about this, for one would think that in a sawmill there would be sawdust everywhere. "If wood dust were allowed to float about in the air, a serious explosion might occur—just as coal dust in a mine or flour dust in a flour-mill can catch fire and explode. Besides this, it would be bad for the health of the workmen if they breathed the dusty air. Over each cutter on the machines there are pipes, which suck away the dust."

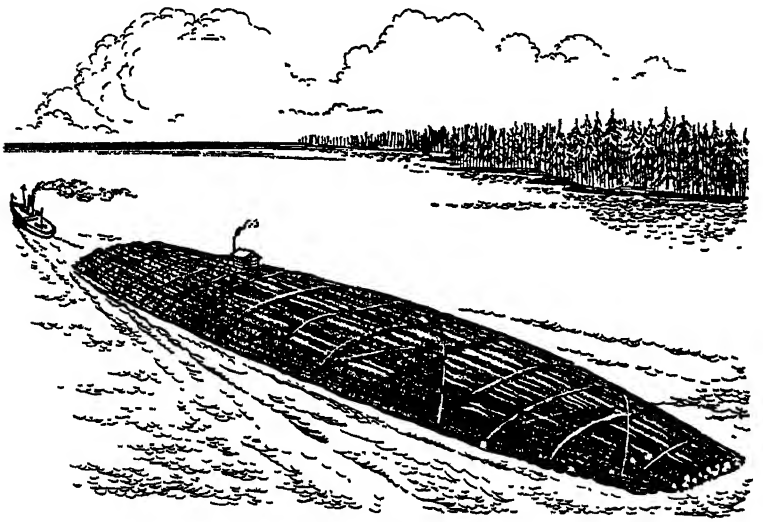
"What do you do with all the waste wood and sawdust? There must be a great deal of it," we ask.

"None of it is wasted. The sawdust and shavings help to heat the boilers that make the steam to drive the machinery. Much of the waste wood is sold for burning. What is left we burn ourselves, for useful chemicals can be obtained from the smoke and ash."

We now follow the manager to the mill yard, where the finished wood is stored in great piles. Men are at work loading the planks on lorries or railway trucks.

"Where does the timber go?" we ask.

"To many places," the manager replies with a



Sea-going Raft of Logs

smile. "Although people call this the age of steel, they are using more wood than ever before.

"Many of these planks will go by rail to the sea-ports, where they will be loaded on ships that will carry them to Britain. Most of our timber, however, goes to the United States of America. Great Britain buys the greater part of her wood from Norway,

Sweden, Finland, and Russia, for they are so much nearer to her.

"Some of the timber will be bought by builders, who will use it for floors and roof beams of houses. Machines, rather like the planing-machines you have just seen, quickly shape the wood so that it can be made into doors or window-frames.

"Wood from the heart of the tree goes to the railway companies to be made into 'ties'—sleepers, they call them in Britain. Before these are used they will be soaked with creosote, which prevents the wood from decaying.

"Some parts of the tree will go to the shipyards, others to aeroplane factories. In fact, it would take a long time to tell you of all the uses that will be made of the timber you see here."

As we climb into our 'plane we thank the kind manager. Soon we are flying high over the smoking chimneys of the busy sawmill.

CHAPTER IV

# *The Story of a Match*

ONE DAY in 1827 an Englishman, John Walker, was mixing some chemicals in his chemist's shop. By accident he rubbed the piece of wood with which he had been stirring the mixture on some sandpaper. To his surprise the wood burst into flame. At once he saw that he had made a useful discovery.

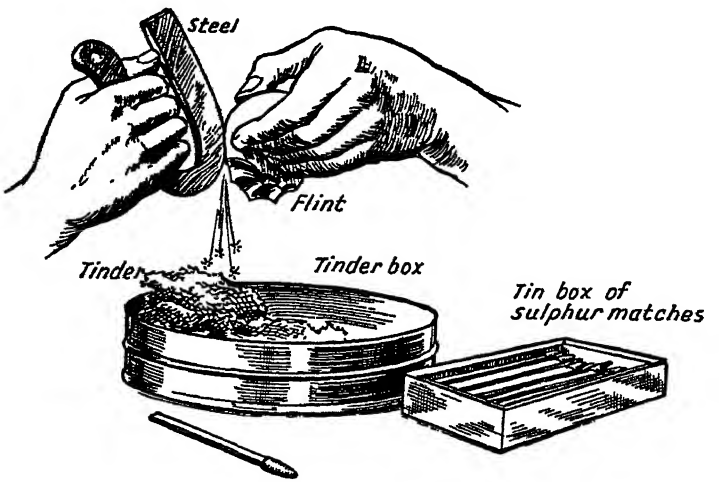
In those days it was not easy to light a fire. On every mantelpiece was a tinder-box in which were flint, steel, tinder, and sulphur matches. To strike a light the steel was struck against the piece of flint. The sparks were caught on the tinder, which was usually a piece of charred linen or cotton. When this began to smoulder a match, which was a thin piece of wood tipped with sulphur, was lit from it.

John Walker dipped sticks of wood into the mixture he had made, packed them in tin boxes with pieces of sandpaper, and sold these first matches that could be struck at 1*s.* 2*d.* a hundred. It was not long before other people began to make matches, and soon the match-box replaced the tinder-box on the mantelpiece.

Let us visit a match factory and see how tree-trunks and certain chemicals are turned into matches.

In the factory yard we see piles of logs from twelve to twenty inches thick. We are told that most of these are aspen, though some pine wood is used. We follow the logs into the mill, where they are cut by circular saws into lengths of three feet. With hand knives men quickly strip the bark from these pieces.

"Now," says our guide, "the timber is ready to be




Tinder-box and Matches

made into matches. Here is the first machine; it cuts the wood into sheets."

As we watch, one of the lengths of tree-trunk is placed in the machine, which grips it at each end. The man who is attending to the machine moves a lever and the log begins to turn like a roller. A sharp knife is moved against the wood and it is

quickly cut into a long sheet three feet wide and as thin as a match-stick.

" We call these sheets 'veneers.' Now you will see how they are cut into matches."

We pass to another machine, to which a pile of veneers is being fed.

"In that machine knives cut the veneers into match-sticks, or 'splints,' as we call them. At this end you see them pouring out. Fifty thousand splints are cut each minute," explains the guide.

The splints pour from the machine into trays, which shake them backwards and forwards. "That is to make them take up less room," our companion continues. "Soon they will be lying neatly in one direction."

Next they are put into large drums, each of which holds a million splints. The drums carry the splints to a bath of chemical in which they are soaked for about five minutes.

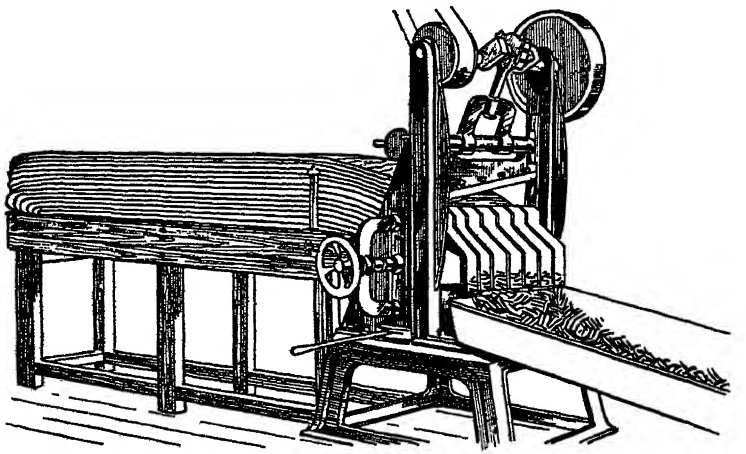
"This prevents the matches from smouldering after they are blown out," the guide tells us. "After they have been soaked, the splints are shaken in the drums for two hours. This dries and polishes them."

The splints are now blown along a tube to another part of the factory. "They must now be sorted," says our guide. "You will see how it is done."

The splints are now shaken about on a belt covered with holes, through which fall any sticks that have been cut too small. They pass next to another belt, which

is covered with slots into which they are shaken, all lying in the same direction.

"We are now going to the match-room," says the guide, leading the way. We enter a large room where dozens of huge wheels are slowly turning. Round these are broad steel bands covered with rows of thousands of holes. In each of these holes is



Chopping Matches from Veneer Sheets

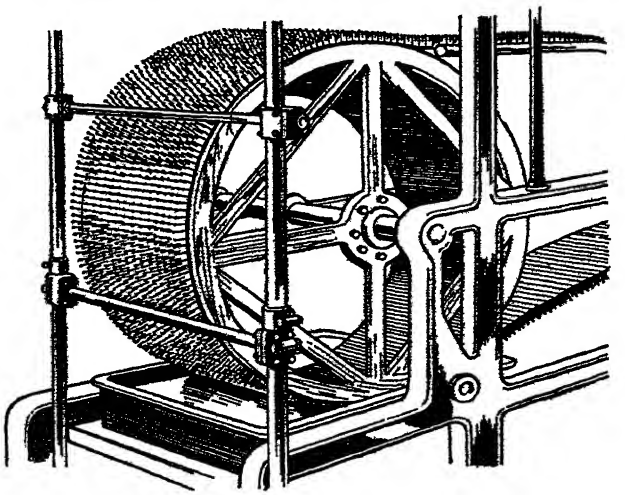
stuck a splint. So close together are these match-sticks that the bands look like great brushes of which the splints are the bristles.

"It looks rather like an army on the march," smiles the guide. "Here is the belt that brings the splints from the sorting-room, which we have just left."

This belt places a row of matches, lying side by side

in their slots, opposite a row of holes in the moving band. At exactly the right moment an arm pushes them into the holes.

"Perhaps you have noticed the mark at the bottom of a match-stick where it has been squeezed into the hole," says our guide. "Let us follow the splints on their long journey. This journey lasts over an hour and is four hundred feet long. When they reach its end they will be matches."



Dipping Match-heads

We watch the slowly moving belt with its hundreds of thousands of match-sticks. First it carries them through a bath of melted paraffin wax. This, the guide tells us, makes the matches burn well. Then the band passes over many wheels, up and down, over and under, while fans dry the splints with hot air.

After almost an hour the sticks are dry and the band dips the ends of them into a bath of chemical. This gives each match its head. Then the journey continues until the heads are dry.

We have now reached the end of the long machine. The matches are pushed out of the holes and fall into metal boxes on a moving belt. These boxes are the same size as match-boxes.

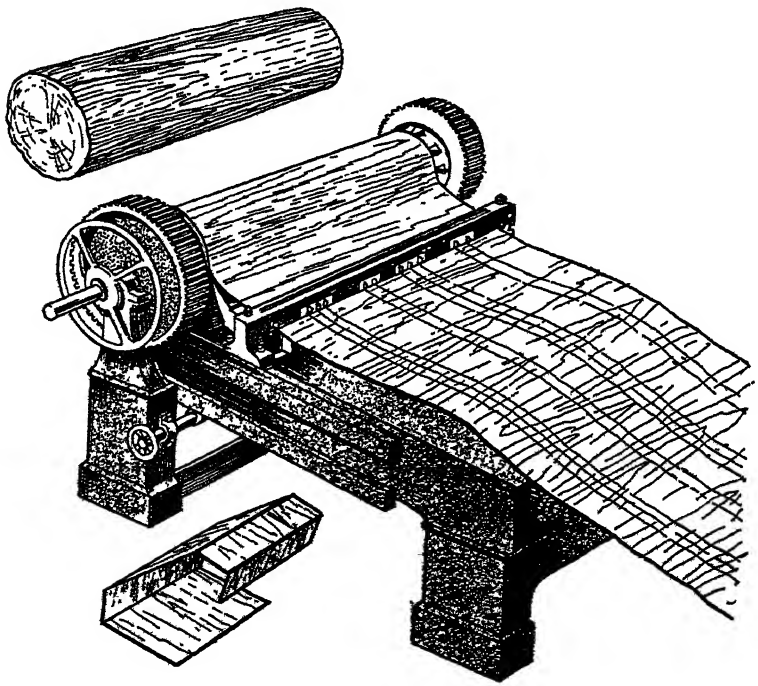
Now, on another belt, the match-boxes arrive. As if by magic they open and into them drop the matches, fifty into each. As the belt moves on, the boxes are shaken to straighten the matches; then they are closed and away they go to the packing room.

"By the machine you have just seen," says the guide, "more than 840,000 matches are made in an hour. Before we go to the packing room let us see how the match-boxes are made."

In another part of the factory we watch a machine like the one that cut the veneers from which the splints were made. It cuts the logs into very thin sheets. At the same time these sheets are cut half through, where they are to be bent.

A match-box is in two parts: the drawer and the outer part. We watch the machine that makes the drawer bend a strip of veneer round a piece of metal, which is the size of the drawer. The bottom is placed in position and paper is pasted over to hold the drawer together. This is done very quickly and the finished drawers are carried by a belt to the drying room.

Another machine makes the outer parts by bending pieces of veneer round metal blocks and sticking them with paper, on which is printed the name of the matches and of the firm that has made them.



Cutting Match-boxes from Log on Veneer Cutter

The strip of sandpaper on which the matches will be struck has already been pasted in position on the paper. In the case of safety matches, which will only ignite when struck on their own box, the striking-strip

contains a chemical which combines with the special head of the match and causes it to burst into flame.

Another machine puts together the inner and outer parts of the boxes.

We follow the guide to the packing room. A belt carries in the full boxes of matches at a great rate. A machine picks up a dozen boxes and places them neatly in the middle of a sheet of paper. Arms fold the paper over the boxes and they pass to another machine, which fastens the packet with a label on which is the name of the makers. A belt takes the packets to girls, who pack them in wooden boxes. A machine nails on the lids.

We watch as boxes are loaded on to lorries. "They are on their way to the warehouses of merchants, who will sell them to the shops," the guide tells us. "Now you understand why matches are so cheap. If they were made by hand, they would cost a great deal more than they do now!"

CHAPTER V

# *Some Useful Products of the Forest*

WHEN WE visited the sawmill in Canada, the manager told us that most of the planks cut there would be taken to the United States of America, but that some would go to Great Britain. Let us see what uses will be made of them.

The railway companies use much wood for sleepers. These are carefully made, for the rails must lie true, and the wood, which is exposed to all weathers, must not rot. If we visited a sleeper yard, we should see great stacks of sleepers standing in the open. They remain there for six months so that they will become well seasoned. They are then taken to a machine that drills holes in exactly the right place for the chairs, which will hold the rails in position, to be fixed. The sleepers are now soaked with creosote, an oil which prevents the wood from rotting. When the chairs have been bolted into position, the sleepers are ready to take their places on the railway.

Other timber will be used to make the doors, window-frames, floors, and beams of houses. A hundred years ago it took a joiner many hours to make a door or a window-frame. Now these are turned out in hundreds by machinery. Some of the

machines work like the planing-machines we examined in the sawmill. Quickly they cut the moulding on skirting-boards or on the edges of the planks that will be made into doors or window-frames. Other machines cut slots in the timber so that it can be joined together. When a builder needs doors for the houses he is building, he does not ask a joiner to make them for him. He can get as many as he wants and much more quickly from the factories.

Most likely the panels of the doors are of plywood. Let us see how this is made.

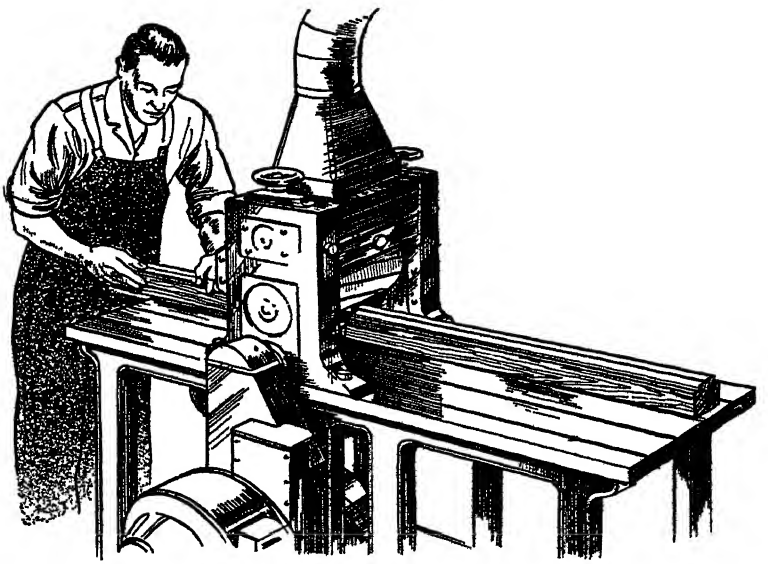
Have you ever tried to break up a tea-chest? Although the wood is very thin, this is no easy task, for the chest is made of three-ply wood. Three sheets of wood, little thicker than what is used to make match-boxes, have been glued together. The grain of the middle piece runs across the grains of the two outer pieces, and the result is a sheet of plywood much stronger than solid wood many times as thick.

Various timbers are used to make plywood—alder, birch, Gaboon mahogany and pine being the commonest. Most of the alder and birch comes from Northern Europe, Gaboon mahogany is grown in West Africa, and the Oregon pine (Douglas fir) grows in the west of Canada and the United States.

Perhaps you remember how the veneers were cut in the match factory. The sheets of wood are cut in very much the same way in a plywood mill. Quite thick trunks are used. After they have been sawn into lengths the bark is stripped from them and they

are fixed in cutting-machines. As the log turns like a roller, a knife cuts it into a thin sheet. It seems as if the sheet is being unwound from the log.

As the wood has now to be seasoned, the sheets are taken to the driers. When the moisture has been removed, the sheets are covered with glue and laid



Modern Planing and Moulding Machine

on top of each other, so that the grain of each sheet runs at right-angles to the grain of the sheets above and below it. Sometimes over twenty veneers are glued together in this way to make one board. The sheets are now put into large steam presses until the glue has set. Then they are cut to the correct size and sent to where they will be used.

Plywood is very useful, for it is many times as strong as solid wood of the same thickness. Ordinary planks cannot be wider than the thickness of the tree; but sheets of plywood can be of almost any width.

We have seen that tea-chests and door-panels are made of plywood. It has many other uses. Sometimes the outside veneers are of beautiful woods such as mahogany or walnut. From this "faced" plywood, furniture that is both strong and light is made. A great deal of the woodwork in the cabins of ships is of plywood.

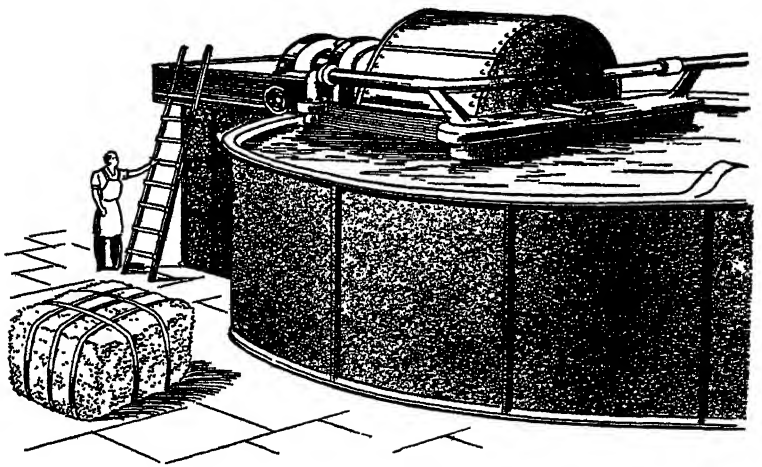
All but the best-quality paper is made from wood. In the eastern parts of Canada are great forests of spruce, hemlock, and balsam. Although these trees are not so large as the giants we saw when we visited the lumber camp, they are felled and floated down the rivers in the same way. Instead of to the sawmills they go to the pulp-mills, where they are made into wood-pulp.

Machinery tears the wood to pieces, breaking it up into its fibres. After this has been mixed with water and treated with chemicals which bleach it, it is pressed into flat sheets and sent to the paper-mills. Perhaps the wood from which the paper of this book is made once floated down the River Ottawa.

The chemist would tell you that the fibres of wood are made of cellulose. In the last hundred years many wonderful things have been discovered about this substance. By experimenting with cellulose the scientists have learned how to imitate the silkworm

and make a beautiful fabric called artificial silk, or rayon. When cellulose made from wood-pulp or cotton is treated with nitric acid it becomes nitro-cellulose, or guncotton, which is used to make cordite and other explosives.

Chemists also discovered how to make from cellulose a material called celluloid. This could be used



Bale of Wood-pulp and Pulping Machines

instead of the expensive ivory or tortoiseshell for making buttons, knife-handles, spectacle-frames, and many other articles. But celluloid easily catches fire, so experiments were carried out which led to the discovery of another "plastic." This is called "cellulose acetate" and it does not burn easily. Ash-trays, fountain-pens, lamp-shades, the handles of

tooth-brushes, and even furniture can be made from this beautiful material. Chemists say that many articles that are now made of wood, metal, pottery, or glass will be made from cellulose acetate and other plastics.

When we visited the sawmill we saw that the bark from the logs went with the sawdust to feed the furnaces that drove the machinery. Bark has uses other than this. Before hides can be used for making boots and shoes they must be turned into leather. This is the work of the tanner. He leaves the hides for several months in pits filled with water in which powdered bark has been soaked, so that the tannic acid in the bark turns the hide into leather. For the best leather the bark of the English oak is used, but as there is not sufficient of this to supply all the tanneries, other barks have to be used as well.

In Spain, Portugal, and North Africa the cork-oak is grown especially for its bark. When the tree is sixteen years old a ring is cut round the trunk just above the ground and another below the lowest branches. Then upright cuts are made joining the rings and the bark is taken off in strips. This first crop of cork is coarse and is used for tanning leather. Eight or nine years later the new bark is again cut. This second crop is of a finer quality and can be used for making life-belts and floats for fishing nets. Each time the tree is stripped the cork becomes finer, until at last it can be used for making bottle corks. Before the strips of cork are sent to the factories they are pressed flat, heated, and scraped.

Cork is also made into linoleum. It is first ground to a powder, then it is mixed with oil and rolled into sheets by hot rollers. The sheets are then again

Cork-Oak Bark

ground to powder. This powder is spread on sheets of canvas, which will form the back of the linoleum, and heavy rollers press the cork and the canvas together.

The rubber-tree is grown for its sap. In the rubber plantations in Malaya coloured workmen slit the bark of the trees and collect the sap as it flows out. After being treated with chemicals this sap is made into the many articles of rubber that are so necessary in our times.

Turpentine, resin, and certain kinds of gum that are used in the manufacture of paints and varnishes, are also obtained from trees.

In this chapter we have mentioned only a few of the interesting and useful things that come from the forest trees. If we had time we could watch the clever cabinet-maker working on fine pieces of furniture and using beautiful woods. We could see straight fir-trees being made into telegraph-poles, and trees that are too small to be cut into planks being sawn into pit-props, which will support the roofs of the underground passages of coal-mines. We must now pass on, however, and examine some of the most useful sorts of timber.

## CHAPTER VI

# *Some Useful Kinds of Timber*

WE CANNOT even mention all the different sorts of wood, for there are too many. For example, botanists know of three hundred kinds of oak! In this chapter, then, we shall describe only some of the most useful kinds of timber.

Cone-bearing trees are usually said to be of soft wood, while wood from trees like the oak and the elm, which drop their leaves in winter, is known as hard wood.

The names given to the softwoods are rather confusing. For instance, the commonest kind of softwood is usually called "deal." Deal is not really a kind of wood, but a plank of a certain size.

The most useful softwood is known as either red or yellow deal. It comes from the tree whose proper name is *Pinus sylvestris*, which is called either the Scotch fir or the Baltic redwood. It is brought to Britain from Northern Europe. Red deal is the wood the joiner uses for most of his work, for it lasts well in the open air and is easy to saw and plane. Most of the woodwork of houses, such as the doors, window-frames, and beams, is of this useful timber. It is often used in Great Britain for railway sleepers.

Baltic whitewood, or white deal, is from the white pine, which also comes from Northern Europe. It is a cheaper wood than red deal and often has many knots. As it does not wear well in the open, it is used for cheap indoor work and for making packing-cases. Much of this wood is made into pulp.

These trees of Europe, although often a hundred feet in height, are small compared with the giants of America. The great trees that were being felled when we visited the lumber camp were Columbian pines, also known as Oregon pine and Douglas fir. As these reach three hundred feet in height and are eight or even ten feet thick, fine timber can be cut from them. This is both strong and light and lasts well out-of-doors.

A well-known wood is pitch-pine, which grows in the south of the United States of America. Turpentine is obtained from this tree. The wood is easily known by its dark, well-marked grain and its strong smell of resin. It is a strong wood and wears well in wet places, so that it can be used for bridges, piles, and street paving. Woodwork in churches is often made of pitch-pine.

Before we turn to the hardwoods, we must mention the giant sequoia, or Californian redwood. This great tree grows on the mountain slopes of California, U.S.A., and sometimes reaches a height of 340 feet. Most trees grow from seeds; but the sequoia, as well as dropping seeds, sends up shoots from its roots, like the raspberry, and these develop into trees growing

in a ring round their parent. The timber from the sequoia lasts well in the open air, but it is not so strong as the other softwoods. As it resists moisture, it is

Grand Californian Redwood

often used to make posts that are to be driven into the ground.

The most useful of the hardwoods is the oak.

Britain used to have great oak forests, but so strong and useful is the wood that these were felled for many purposes. We have seen that ships used to be made from this wood. It was also used for the framework of houses, just as steel girders are used now. There are many fine old houses with frameworks of oak beams, the spaces between being filled with brickwork. The wood has remained for hundreds of years exposed to the wind and the rain, and it is as sound as when it was first put there.

The oak-tree lives to a great age and there are some giant trees which are said to be over a thousand years old.

Oak is used when a strong wood that will stand the weather is needed. As it has a beautiful grain, it is often made into furniture.

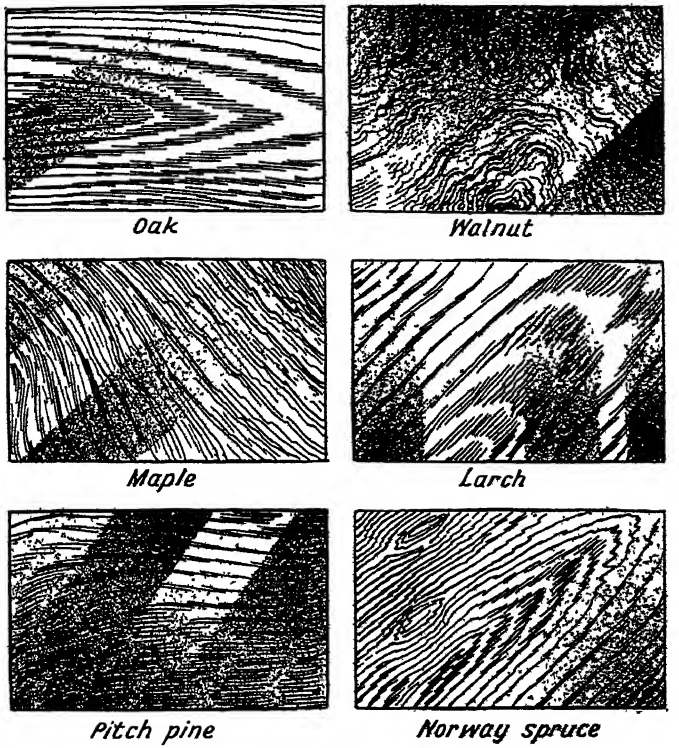
The elm is another wood that wears well in the open air. It is made into the keels of boats, wheels, barrows, and furniture.

The ash is almost as useful as the oak, for it is hard and tough. The handles of tools are usually made of this wood and a great deal of it is used for making wheels, carts, and oars.

Hundreds of thousands of chairs are made each year from beech wood. It is also used for sabots, or wooden shoes, and for the soles of clogs, for the grain is so close that water does not soak through it.

More than two hundred years ago a ship reached England from Cuba. As she was sailing home without a cargo her hold was filled with ballast. Instead

of the usual sand or stone, she had been loaded with tree-trunks of a strange, heavy wood. Perhaps the captain thought that he would be able to sell this




Various Grains

wood in England; but when joiners found how hard it was, they refused to have anything to do with it.

By chance a cabinet-maker obtained a small piece of this timber and with it made a little wooden box.

So beautiful was this that people began to ask for furniture made from this new wood. That is how mahogany first became known in Great Britain.

There are many kinds of mahogany. The best comes from Cuba and Honduras and other kinds from Africa. The best wood is very expensive, logs having been sold for more than £1,000. It is made into beautiful furniture.

Walnut, which is another furniture wood, comes from the Mediterranean and America. As this wood is strong and light, the stocks of sporting guns are sometimes made of it.

The most important timber that comes from India, Burma, and Siam is teak. This wood is even better than oak for ship-building, and large quantities are used for railway carriages and tramcars. The insects that attack most woods will not go near teak. The great tree grows in the thick jungles, and the wood is so heavy that it is difficult to drag it to the rivers which carry the logs to the sawmills.

Two years before the trees are felled, deep rings are cut round the bottoms of the trunks. This stops growth and the wood dries, making the log lighter, so that it can be more easily dragged to the river and floated to the mill. Elephants are often used to move the timber, both in the forests and at the mills.

In this chapter we have spoken only of the most used timbers. Besides these there are many others, such as the very light balsa, which is used in making aircraft, the heavy ebony and lignum vitæ, and the

kauri pine from New Zealand. This last timber gives valuable gum which can be made into varnish, as well as its useful wood.

There are the jarrah and the karri woods from Australia, the cedar of which pencils are made, the many kinds of palm which are important for their dates, oil, and leaves rather than for their wood. There are also the different kinds of wood from which pulp and plywood are made, which were mentioned earlier in this book.

CHAPTER VII

# *Timber in the Age of Steel*

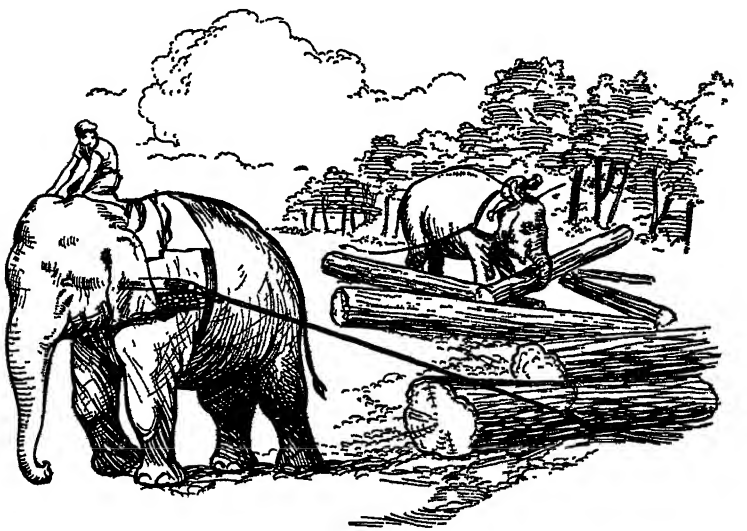
WE HAVE seen how timber is felled in the forests, how it is taken to the mills to be turned into planks or wood-pulp. We have visited factories where many useful things are made from wood. All the work we have seen has been done by wonderful machines, which work more quickly than hundreds of men. This has not always been so, for working in wood is one of the oldest crafts.

When man, unlike the animals, began to take tools in his hands to help him to live more comfortably or to fight his enemies, he turned to the trees of the forest to provide him with these tools. A straight branch would serve as a staff to help him on his way or as a club to fight his enemies. A pointed stick would make a spear. Fallen branches fed his fire. A forked branch became the first plough.

It was when man, no longer satisfied with rough branches, began to shape wood to suit his needs that he turned to stone to provide him with tools hard enough to cut wood. So it was that man became a woodworker.

The Stone Age has gone, and so have the Bronze and Iron Ages, which followed it. Now we have the

age of steel. It is easy to forget how important was the woodworker in the old days and, in fact, how necessary he still is. Before the coming of the great machines many things that are now of metal were made by hand by the woodworker—the frames of houses, furniture, coaches, ships, wagons. Every



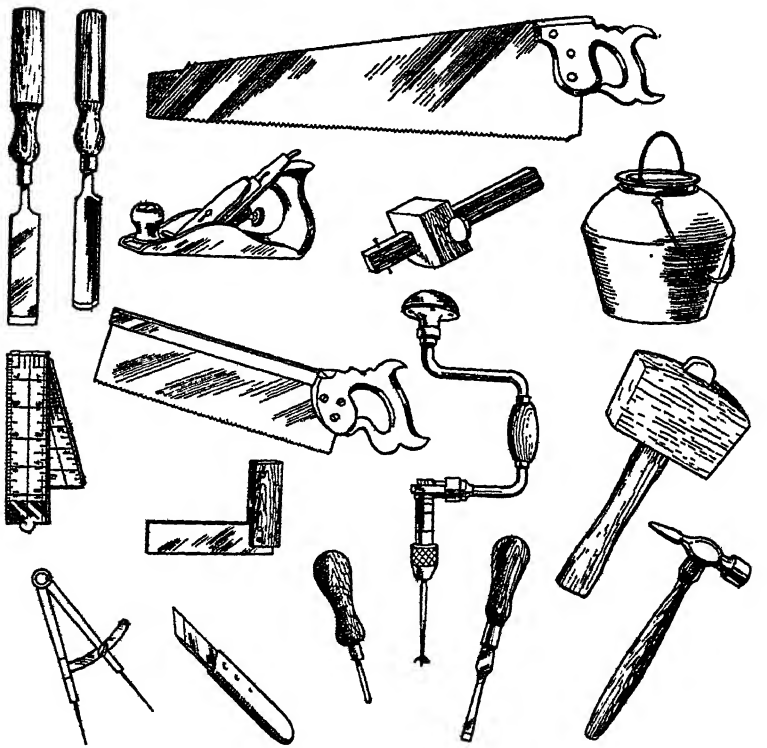
Hauling Teak

town had its carpenter, its wheelwright, its coach-builder, all of whom were workers in wood.

Then came the great factories, with their wonderful machines. Men learnt to make steel cheaply and that strong, light material soon took the place of wood for many articles.

In spite of this, we cannot do without timber and

we are using more of it than ever before. We still have wooden doors and floors in our houses, for they are warmer than steel. Most of our furniture is still



Carpenter's Tools

of wood, for wood is beautiful. Our garden sheds and hen-houses are usually of wood, for wood is cheap. If a man wants to make a stool, a barrow, or a toy, he uses wood, for, unlike steel, it can easily

be worked by hand. There must, indeed, be few men or boys who have not at least some wood-working tools with which they can do odd jobs.

So important is timber to the life of man that, even in this age of steel, it is difficult to think of things in the making of which wood has not played a part. The very coal from which we obtain so much of the power that drives the machines, and which has made possible the Steel Age, is formed from the timber of ancient forests. Indeed, few of the many things which man requires to enable him to live in comfort could exist without timber.

## THINGS TO DO

### *Chapter One*

1. How would the woodmen move the heavy trunks?

2. Draw a picture of a warship of Queen Elizabeth's time.

3. Find out about Drake's voyage round the world and tell this exciting story in your own words.

4. Fill a syrup tin with pieces of wood. Punch a hole in the lid and stand the tin in a hot fire. When smoke no longer comes from the hole, your will find that the wood has been turned into charcoal. Draw a picture showing how a charcoal burner makes charcoal.

5. Why did England lose her great oak forests?

### *Chapter Two*

1. Write a story called "The Forest Rangers to the Rescue."

2. Find out why there are many Frenchmen in Canada.

3. Draw a bird's-eye picture of a lumber camp, showing the clearing with its huts, bunk-house, etc., and the yard with the yarder, the railway, the river, and so on.

4. Explain how a tree is felled.

5. What do the following words mean: yarder, feller, high-rigger, spar, yard, spring-board, undercut, flume, telpher, bunk-house?

*Chapter Three*

1. What is a log jam? How do the lumberjacks deal with it?
2. Draw a bird's-eye picture of a sawmill.
3. How are the logs taken from the river into the sawmill?
4. What happens to the logs that are too small to be cut into planks?
5. Draw a plan of the slope, log-loader, saw, and conveyer.
6. What do the following mean: peevie, boom-grounds, slipboard dogs, log-loader, sawyer, setters, drying-rooms, planing-machines?

*Chapter Four*

1. How was fire made before matches were invented?
2. Tell the story of the invention of matches.
3. Tell the story of how a tree-trunk becomes a match.
4. Why are matches so cheap when such expensive machinery is required to make them?

*Chapter Five*

1. How is plywood made? Why is it often more useful than ordinary wood?
2. What is cellulose?
3. What are plastics? Can you find three articles made of plastics?
4. What work is done by a tanner?

5. How many things can you think of, other than wooden articles, that are made from timber?

*Chapter Six*

1. Here is a long list of different woods. All of them are mentioned in this book. Copy them out; then, opposite each of them write, first the name of the country from which it comes and then what it is used for.

Scotch Fir (red deal).
Baltic Whitewood (white deal).
Columbian Pine.
Californian Redwood.
Oak.
Ash.
Beech.
Mahogany.
Pitch-Pine.
Teak.
Walnut.
Ebony.
Lignum vitæ.
Balsa.
Kauri Pine.
Cedar.
Hemlock.

2. What is meant by hardwood and softwood?
3. How did mahogany come to be known in England?
4. What do you know about teak?

*Chapter Seven*

1. On an outline map of the world shade the countries from which timber is exported. From which countries do we get most of our timber?
2. Make a list of carpenter's tools and say what each is used for.
3. If you were going to fit out a small workshop, what tools would you choose?

## STORIES OF INDUSTRY

by HARRY McNICOL

Each volume tells the story of one of the great industries—its origin, its development through the craft stage, its technology and organisation, and its contribution to our way of life. The stories are exciting and the young reader will find himself transported into strange lands. Thus he will come to realise how dependant we are upon one another for the satisfaction of our needs. Each story ends with practical suggestions of things to do, which will appeal to the reader's desire to find out for himself.

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**TIMBER**—tells the story of trees and their service to man.

**PAPER**—the invention of paper and the processes which it undergoes before it reaches us in its various forms.

**IRON AND STEEL**—the wonderful history of these essential metals, showing the development in their use from earliest to modern times.

**TEXTILES**—the process of making cloth described in simple detail. Various kinds of cloth and their introduction into this country.

**PETROLEUM**—the sources of oil, its usefulness to man, with simple description of the process of refinement.

**RUBBER**—a vivid account of the discovery of the many uses of rubber, with descriptions of a rubber plantation and a rubber factory.

**TEA AND COFFEE**—the full story of how these popular commodities are brought to us in our homes.

**SUGAR AND COCOA**—describes the growing of sugar-cane, sugar-beet, and cocoa beans, their preparation, and finally the use of the two products, sugar and cocoa, in a chocolate factory.

**GLASS**—the story of the development of glass through the ages and an account of modern methods used in glass production.

**POTTERY**—the craft of pottery described in all aspects from earliest times to the present day.